Surface Currents Connect South Florida and the Keys

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The entire coastal ecosystem of South Florida is connected by water exchanges through the tidal channels between the Keys and by the patterns of stronger oceanic currents, according to scientists from the National Oceanic and Atmospheric Administration and the University of Miami's Rosenstiel School of Marine and Atmospheric Science. The interconnected coastal ecosystem consists of three distinct subregions: Florida Bay, a shallow lagoonal system of banks and mangrove islands; the Southwest Florida Shelf, an underwater extension of the Florida peninsula on the Gulf side; and the Florida Keys Coastal Zone, a narrow shelf on the ocean side which contains the Florida Keys coral reef tract and the Keys (Figure 1).

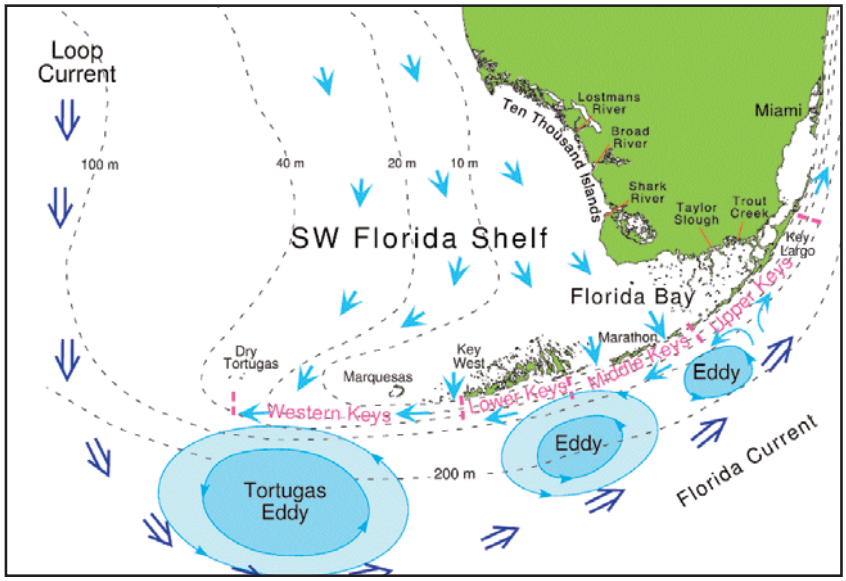

Figure 1. The southwest Florida Shelf, Florida Bay, and the Florida Keys form the three main subregions in the area. Note the Loop Current, which becomes the Florida Current on the Atlantic side of the Keys.

Eddies, temporary circular currents that spin off the larger oceanic currents, are found on the ocean side of the Keys and strongly influence the Keys Coastal Zone (Figure 1). In fact, these currents appear to be important for keeping marine larvae spawned in the Keys and elsewhere in the Caribbean in the region.

Scientists have measured flow rates through the Keys tidal channels for several years. These measurements indicate that the net flow of water is from the shelf/Gulf toward the reef tract, with most of the water moving through the Long Key and 7-Mile Bridge Channels (Figure 2). The intrusions of salty, cold Bay and shelf waters that flow toward the reef tract commonly during the winter dry season may remain intact well past the shallow reef and down to intermediate depths.

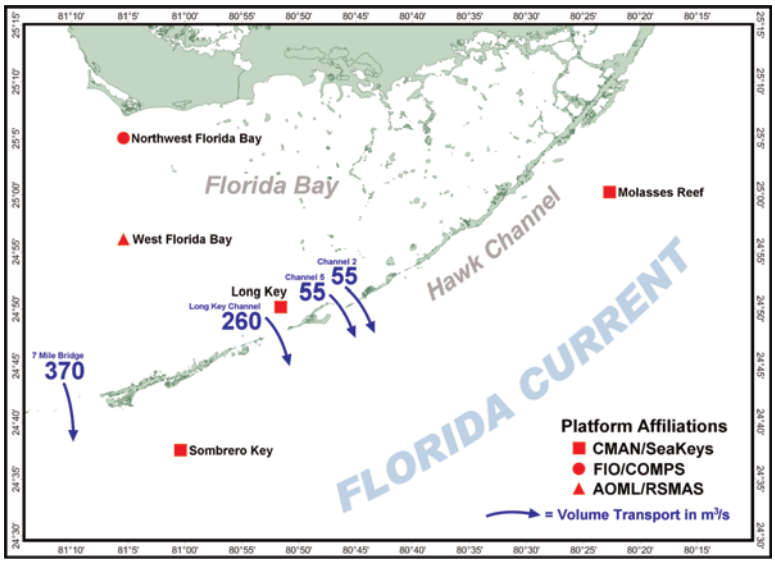

Figure 2. Arrows depict the average (subtidal) flow rates through the tidal channels of the Keys, measured in cubic meters per second. Average flow rates are greatest through the 7-Mile Bridge Channel.

Scientists have also been using surface drifters, which are released off of southwest Florida and tracked by satellites, to study the pathways of surface waters in South Florida. Based on several years of drifter data, they have concluded that there are three common pathways, which vary depending upon the season of the year. Generally, in the winter and spring, the primary movement of drifters is to the southeast through the channels between the middle Keys (Figure 3). In the fall, the typical pathway is toward the Dry Tortugas. During the summer months, drifters tend to move northwest off southwest Florida to join the Loop Current. After reaching the Keys coastal waters, drifters following all three pathways either recirculate in coastal eddies and wind-driven countercurrents for several months

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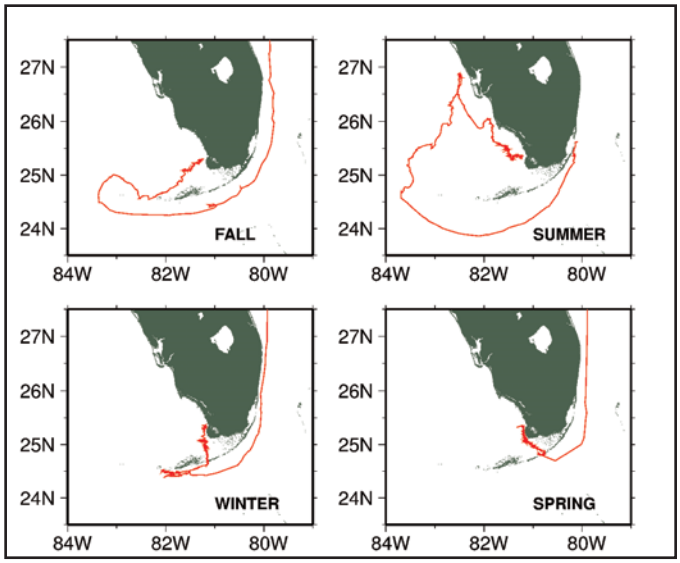

Figure 3. Satellite-tracked surface drifter trajectories help to trace the surface water flow through the region. Three common pathways are apparent based on drifter data collected over several years.

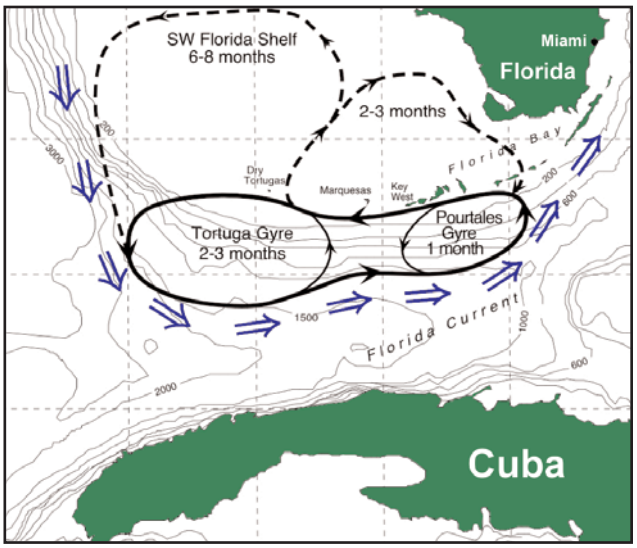

Figure 4. A schematic map portrays the regional circulation pattern. The Loop and Florida Currents are shown by the large open arrows. Approximate time scales are indicated within the various eddies.

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or become entrained in the Florida Current and are moved out of the coastal ecosystem (Figure 4). All pathways demonstrate that water from the Shelf/Gulf/Bay flows into the nearshore areas of the Florida Keys, underscoring the connectedness of the marine and estuarine environments in the South Florida region.

Note: The information and figures for this article were presented by Dr. Elizabeth Johns, NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML), at the Florida Keys National Marine Sanctuary Science Symposium in Washington, D.C. in December 2001. A written report, "Monitoring Circulation and Exchange of Florida Bay and South Florida Coastal Waters with Real-Time Data Links" appears in the ***Sanctuary Science Report 2001****, available on the Sanctuary home page:* **www.fknms.nos.noaa.gov/research.** *The study is a joint effort between Dr. Thomas Lee, University of Miami Rosenstiel School of Marine and Atmospheric Science and Drs. Elizabeth Johns and Peter Ortner, NOAA's AOML.* **Sounding Line** *thanks Drs. Elizabeth Johns, Thomas Lee, and Peter Ortner for their contributions to this article, which first appeared in the Winter 2002 issue.*

Circulation and Currents in South Florida and the Keys

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